(3.7) Physical Resources

(3.8) Air Resources

(3.8a) Existing Condition and Resource-Specific Information

There were no public issues specifically related to the air resource. Prescribed burning to create barrens habitat is the main activity that would have the most potential impact to the quality of the air resource. For this reason, the effects analysis for the air resource focuses on the effects from prescribed burning activities. The analysis also discusses greenhouse gas emissions and its contribution to global climate change.

Site-specific burn plans are developed for each burn unit. These plans outline the environmental conditions required for conducting burn activities (i.e. wind direction, humidity, and temperature thresholds), the amount of resources required, the desired time of year, contingency plans, and any site-specific burning restrictions that may apply. Burn units are developed by considering existing control lines (i.e. roads, plow lines, etc.), fuel types, and natural features. The size of individual burn units can vary considerably, but efforts are made to keep the burn units to a size than may be safely completed within one operational period (one day).

Affected Environment: Frequent weather fronts pass through the Project Area, especially in the spring and fall, resulting in southeast, south, west and northwest winds (VCIS 2009). Prevailing winds during the burn season (March to November) are generally south to west, with local onshore winds out of the west that dominate prevailing winds during calmer weather. Mixing heights vary, but average 4,200 feet in the afternoon during burning season (VCIS 2009).

Projects implemented by the Forest Service must follow all State and Federal regulations governing air quality, including meeting ambient air quality standards (NWCG 2001). Chief among these is the Clean Air Act (CAA) as amended in 1990, and the Draft Michigan State Implementation Plan (DMSIP), which is a state prepared implementation document of the CAA. The Michigan Department of Natural Resources and Environment (DNRE) is the agency which monitors and regulates air quality in the state.

The CAA prescribes the National Ambient Air Quality Standards (NAAQS) for criteria pollutants to limit the negative human health and welfare impacts from air pollution. These include: Particulate Matter <10 microns in diameter (PM_{10}), Particulate Matter < 2.5 microns in diameter ($PM_{2.5}$), Total Suspended Particulate Matter (TSP), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Ozone (O^3), Carbon Monoxide (CO), and Lead (Pb). Areas failing to meet the established standards are considered "non-attainment areas" and individual states must develop plans to improve air quality in these areas (NWCG 2001).

Particulate Matter: Since October 4, 1996, all areas in Michigan have been in compliance with PM_{10} NAAQS. Due to the recent focus on $PM_{2.5}$, and because of the relatively low concentrations of PM_{10} measured in recent years, Michigan's PM_{10} measurement network has been reduced to minimal levels. On August 18, 2010, the EPA proposed the 7-county Southeast Michigan Area a

non-attainment area for $PM_{2.5}$ based upon 2005-2007 data. In addition, the EPA proposed Kent and Ottawa Counties, on the west side of the state, as non-attainment areas for $PM_{2.5}$ based on this data. The two Grand Rapids monitoring stations recorded a mean annual average of 11.8 and 12.8µg/m³ respectively for Annual Mean Concentrations of $PM_{2.5}$, below the 15µg/m³ requirement (2006-2008). Muskegon County and the Project Area have a 3 year $PM_{2.5}$ average of 10.5µg.m³, also below the average. A detailed assessment of $PM_{2.5}$ (24 hour average) concentrations for 2003-2008 shows Michigan's levels were consistently below the old 65µg/m³ standard (3-year average), and with the exception of Dearborn (in eastern Michigan) and are currently under the new 24-hour $PM_{2.5}$ NAAQS measurement of 35µg/m³. Kent and Ottawa counties are approximately 22 to 25 miles south and southeast of the project area and upwind of the prevailing winds. Because of the distance, prevailing winds and winds permitted for burning the project area should not impact these airsheds.

Background concentrations of PM and other pollutants originate primarily from industrial facilities, automobiles, residential and commercial buildings, agriculture activity, and road dust (USEPA 2010). Some of these sources are temporary (such as smoke from wood stoves, fire places, field burning, and wildfires that often coincide with prescribed burning season), while others are constant (such as industrial sources and power plants). Disking and harvesting activities on agricultural lands can produce large amounts of dust and other particulates; this action is temporary and seasonal, but may overlap with prescribed burning.

Table 3.25: Emissions by Category Report – $PM_{2.5}$ – Tons/Year

County	Industrial/Commercial	Agricultural	Forest Service Prescribed Burn	Other
Muskegon	1,180	183	0	794
Oceana	198	126	70	368
Newaygo	235	13	0	245

Visibility: The CAA also prescribes measures called Prevention of Significant Deterioration (PSD) to limit the impacts to visibility in certain areas. Class 1 areas are those with high air quality that allow only minor additional reductions to visibility (NWCG 2001). There are two Class 1 areas in Michigan, the wilderness portion of the Seney National Wildlife Refuge and Isle Royal National Park. Both of these are in the Upper Peninsula. Sleeping Bear Dunes and Indiana Dunes National Lake Shores, though important scenic areas, are not designated Class 1 areas. None of these areas would be impacted by the project due to their distance from it. The entire Manistee National Forest and surrounding counties are designated a Class 2 area, which follow the normal rules of visibility. Visibility is typically worst during hazy summer days under entrenched high pressure systems and humid conditions or during periods of calm, moist air during or preceding rain, snow, or fog events.

There are three types of prescribed burning; growing season, dormant season, or pile burning. Dormant season burning occurs in the spring and fall when plants are not exhibiting growth. Growing season burning occurs during the summer months when plants are actively growing and pile burning occurs in the late fall, winter or early spring when the ground is either snow covered or wet. Since prescribed burning requires dry unstable air, most of the burning will

occur during drier portions of the spring, summer and fall. Therefore, most emissions would not overlap with times of poor background visibility.

Ozone: Ozone (O^3) is an air pollutant that is formed in the atmosphere from a chemical reaction of Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOC's) plus heat. The ozone season for Michigan is considered April- October, which overlaps the prime burning season. The HMNF has two counties on the Forest that were designated as non-attainment areas by the EPA on April 30, 2004 with respect to the 1997 8-hour ozone NAAQS of 0.08 parts per million (ppm). The two counties, Mason and Muskegon, were re-designated to maintenance status by the EPA on May 16, 2007 due to measured improvements in ozone. As a part of this process, the State of Michigan developed EPA approved maintenance plans for these counties (71 FR 70915). The maintenance plans are designed to keep the counties in attainment of the 0.08 ppm threshold through 2018. These plans include county-by-county air emission projections from all types of pollution sources that form ozone, primarily nitrogen oxides (NOx) and volatile organic compounds (VOCs). Sources of NOx include anything that burns fuel. VOCs can come from the evaporation of fuels (e.g. gas stations) or natural emissions from vegetation.

The ozone problem in western Michigan is known to be a regional transport issue and not one of local origin. In their July 15, 2003 letter to EPA regarding ozone non-attainment designations MDNRE (MDEQ) states:

> *"Overwhelming (not regional) ozone transport is the sole reason for nonattainment levels of ozone at many monitors in Michigan. Community support for nonattainment designations and positive actions within some of these areas is hindered because such a designation results in regulatory mandates based on the erroneous premise that a local area should be held responsible for their air quality. Some of the ozone receptor counties in West Michigan have minimal industry and are very sparsely populated. Local emission reductions do not reduce ozone concentrations at shoreline monitors even in counties with urbanized areas."*

As stated above the nature of the problem is a regional-scale phenomenon. The primary pollutants need time to react in the atmosphere before forming ozone. This leads to impacts that are felt at a considerable distance downwind from the pollution sources. This is the case for western Michigan, which includes the counties within the boundaries of the Huron-Manistee National Forest (Wickmen 2010).

Greenhouse Gases: Fires also produce gases that are emitted into the atmosphere such as carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_x), and methane (CH_4). The burning of fossil fuels in internal combustion engines is also a source of these gases. Most of these gases generally pose little or no direct risk to public health since fires are spatially and temporally dispersed, and the emissions are rapidly diluted into the atmosphere near their source (Sandberg and Dost 1990). However, gases such as CO_2 and CH_4 are the primary anthropogenic sources of greenhouse gases that may have a direct effect on global climate change.

The temperature of the earth's atmosphere is regulated by a balance between the radiation received from the sun, the amount reflected by the earth's surface and clouds, and the amount of radiation absorbed by the earth and its atmosphere. Greenhouse gases (GHG) keep the earth's surface warmer than normal because they absorb infrared radiation from the earth and, in turn, radiate the energy back down to the surface. While these atmospheric gases occur

naturally, there has been a rapid increase in concentrations of greenhouse gases in the earth's atmosphere from anthropogenic sources since the start of industrialization, which has caused concerns over potential changes to the global climate. The largest effect on climate change is from CO_2 emissions.

Global emissions are measured in terms of teragrams (Tg), where one Tg is equivalent to 10^6 metric tons. The estimated global CO_2 emission rate from combustion of fossil fuel for the year 2008 is approximately 30,377 Tg (EPA 2010). Scientists continue to assess and estimate the total global effect of warming or cooling of various GHG's. The global average surface temperature in the 1906-2005 time period has increased by 1.3±0.32°F. Eleven of the twelve warmest years globally since approximately 1850 have occurred during the years 1995 to 2006 (IPCC 2007). Future projections of GHG during the 21st century have been made using a number of emission scenarios. Based on model simulations applied to various GHG's, the U.N. Intergovernmental Panel on Climate Change (IPCC) has projected an increase in globally average surface temperatures ranging from 1.1 to 6.4°C (IPCC 2007). This level of global climate change could lead to devastating results such as more erratic weather patterns, coastline erosion and flooding, and widespread ecosystem degradation.

(3.8b) Area of Analysis

The direct and indirect effects analysis area for the air resource consists of the atmosphere covering the HMNF and surrounding private lands. Due to the extent of the burning proposed this document will address the direct and indirect effects on Muskegon, Oceana, and Newaygo Counties of Michigan. These counties are immediately downwind of the Project Area and would experience the greatest impact to their air resource.

The cumulative effects analysis for the air resource related to particulate matter emissions consists of the atmosphere over the HMNF and adjacent private lands up to 5 miles from the Project Area. The reason this analysis area is used is because the smoke modeling for this project indicates that emissions beyond this distance from the burn location are negligible (about 1µg/m³ (24-hour average)). The timeframe for the cumulative effects analysis is 5 to 10 years, since that is the expected time period for the implementation of this project.

The cumulative effects analysis area for the air resource related to other gas emissions consists of the atmosphere with no maximum boundaries. This analysis area was used since these gases are emitted into the atmosphere and persist for long periods of time.

(3.8c) Direct and Indirect Effects

Alternative 1

Under this alternative there would be no direct or indirect effects to air quality resulting from this project, as no activities would take place. Current use and activities that produce pollutants and emissions would continue. In the past, these have not contributed towards excessively degraded air quality and would not be expected to do so in the future. Numerical values for the predicted emissions for all Alternatives are shown in Table 3.27.

The prescribed burning (343 acres) activities associated with the Savanna/Barrens Restoration project would still occur within the boundaries of the Project Area. A wildfire in the Project Area would be likely to produce greater emissions than a prescribed burn of the same size in the same area because it is likely to ignite and burn during periods of lower humidity, stronger winds, higher temperatures and lower fuel moistures causing significantly greater fire behavior and greater fuel consumption.

Alternative 2 & 3

The goal of Alternative 2 is to balance the restoration of the savanna ecosystem with the present recreational experience, and the goal of Alternative 3 is the increased protection of savanna restoration activities from the existing recreational use. The management activities associated with wildlife habitat creation and timber harvesting are the same under both Alternatives 2 & 3 and include 2,542 acres of savanna creation (cutting, seeding, and burning), 1,050 acres of additional prescribed burning, 761 acres of red pine thinning, 519 acres of KBB opening restoration (cutting, mowing and burning) and 23 acres of oak/aspen clear-cutting. This would result in approximately 4,100 acres of initial prescribed burning, with the amount of follow-up burning necessary during the coming decade being dependent on the floristic response. The majority of the burning would be on a landscape level, burning a wide variety of stands in a contiguous burn block at one time. These blocks range from 44 to 988 acres in size with the average size being approximately 450 acres. Because of logistical and biological constraints no more than approximately 2,000 acres of prescribed burning would be implemented annually.

For purposes of predicting smoke emissions, it is estimated that the maximum amount of burning that the Forest could practically accomplish in one day is no greater than 1,000 acres. Modeling results indicate that burning 500 acres of forest land under summer conditions (e.g. 75°F, about 10 mph wind speeds, RH 35%, neutral atmospheric conditions, and a 3,000 ft mixing height) would produce a maximum $PM_{2.5}$ concentration of 29 $\mu g/m^3$ at a distance of approximately 4.5 miles from the fire line. This would be below the 35 $\mu g/m^3$ threshold (24 hour average). Using the same conditions and distances, burning 1,000 acres would produce $PM_{2.5}$ concentrations of 38 $\mu g/m^3$ (24 hour average). This would drop to less than 35 $\mu g/m^3$ (24 hour average) at a distance of 5.9 miles from the burn. It is reasonable to expect the actual $PM_{2.5}$ concentrations would stay below the 24 hour NAAQS of 35$\mu g/m^3$ (24 hour average) if burning conditions were more favorable than those modeled. Modeled conditions predicted a plume rise of 3,000 feet. Observed broadcast burning gives plume rise of 5,000 feet or more which would allow for greater dispersion and less impacts for any given area. Concentrations are not compared against the annual standard since a prescribed burning project is a temporary source of emissions lasting only a few days.

This type and amount of burning is similar to past burning practices on the HMNF. The air quality standards have not been exceeded or substantially impacted be these past activities. While it is predicted that the level of burning proposed under either Alternative 2 or 3 would have short-term site specific impacts to air quality from $PM_{2.5}$ emissions, these impacts would not be substantial.

The GHG emissions from the proposed prescribed burning activities that have the most potential to contribute to global climate change were also estimated and are displayed in Table 3.26.

Table 3.26: Estimated GHG Emissions from a 500 acre Prescribed Burn

Compounds Released	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxides (NO_x)
Emission Results for Burning (lbs)	661,500	31,500	8,000

(3.8d) Cumulative Effects

When considering the past, present, and reasonably foreseeable future, there would be approximately 10,000 acres of annual burning for habitat creation and maintenance. Past burning on the forest has been determined to emit small quantities of PM for very short periods of time. No violations have been issued by the MDNRE or the EPA that would indicate non-compliance with air quality standards. Although the amount burning on the HMNF increases the potential to burn more acres than modeled, the maximum capacity for any given day would be approximately 1,000 acres with an average of approximately 500 acres burned per day. For this reason, the expected cumulative effects from PM emissions would stay below the NAAQS as discussed in the direct and indirect effects. Other sources of air pollution (such as industry, vehicles, and residential wood combustion) would continue to contribute to existing background air quality concentrations, which are generally low. The cumulative effects of these existing sources of pollution, together with the maximum 1,000 acres of daily burning anticipated under both alternatives, would result in minimal impacts to air quality related to PM emissions.

A First Order Fire Effects Model (FOFEM) analysis was used to estimate the primary GHG emissions from the proposed prescribed burning activities that have the most potential to contribute to global climate change (Table 3.27). These gas emissions are based on the maximum amount of annual burning that would occur over a ten year period.

Table 3.27: Primary Greenhouse Gas Emissions from Prescribed Burning

Type of Gas	Alt 2 & 3 Annual Emissions (metric tons/acre)	Alt 2 & 3 5 Year Total (metric tons/acre)	Alt 2 & 3 10 Year Total (metric/tons/acre)
Methane (CH_4)	60	300	600
Carbon Dioxide (CO_2)	12,620	63,100	126,200
Nitrogen Oxides (NO_x)	20	100	200

The net addition to the annual global emission rate for GHG is so small that it would result in no detectable change in the cumulative effects in the atmosphere associated with global climate change. The annual CO_2 output that would be anticipated under the maximum number of acres of proposed activities would be projected at 12,620 metric tons or 0.0012 Tg. The annual CO_2 output from these activities would be approximately .00000495 percent of the estimated global CO_2 emissions rate from combustion of fossil fuels for the year 2000. This net addition to the annual global emission rate is so small that it would have no detectable change in the cumulative effects of CO_2 in the atmosphere associated with global climate change. Since the

amounts of CH_4 and NO_x are even less than that of CO_2 relative to global outputs, no detectable change in the cumulative effects from these gases related to global climate change is expected.